bores which open out into the through-passages, are drilled into the plate body perpendicular to the rear surface, and the end-side openings of the cast-in ducts are closed. Thereafter, connection pipe-ends are inserted into the connection bores and soldered or welded in place, as has already been described above.

The manufacturing methods described in DE-A 2907511 and in WO 98/30345 both enable high-quality cooling plate bodies to be produced from copper or copper alloys. However, compared to cooling plates with integrally cast cooling tubes or compared to shape-cast cooling plates, the finished cooling plates produced by both processes have the drawback of having a relatively high pressure loss in the region of the transitions from the connection pipe-ends to the cooling passages.

WO 00/36154 has suggested to reduce the flow losses in copper cooling plates with integrally cast or drilled cooling passages by inserting a shaped piece into a cutout in the cooling plate body, so as to form a diverting passage with optimized flow conditions for the cooling medium. However, this solution is relatively labor-intensive, which is reflected in higher production costs.

DE-A 3313998 discloses a cooling plate for metallurgical furnaces made of a cast iron body. The cooling plate comprises a channel for cooling fluid formed by a steel tube inserted into a bore which extends longitudinally through the body. The steel tube is fixed within the cast iron body at temperature equilibrium by means of a previous shrinkage fit. This solution requires expensive large size shrinkage fit equipment adapted to the dimensions of the cast iron body and the steel tube.

Summary of the Invention

It is an object of the present invention to provide a simple and reliable method of manufacturing cooling plates for a metallurgical furnace with relatively low pressure losses. It is another object of the present invention to provide a reliable cooling plate with relatively low pressure losses that can be easily manufactured. These problems are solved by a method in accordance with

claim 1, respectively a cooling plate in accordance with claim 24.

A method of manufacturing a cooling plate for a metallurgical furnace in accordance with the present invention comprises the following steps: providing a metallic plate body with a front face, a rear face and at least one channel extending through the metallic plate body beneath its front face; inserting, with radial clearance, a metallic tube into the channel so that both tube ends protrude out of the channel, and achieving a press fit of the tube within the channel. According to an important aspect, the press fit is obtained through a metal-forming process applied to the metallic plate body. This metal-forming process results in shrinking of the section of the channel.

Surprisingly, it has been found that a press fit of the tube in the channel can be obtained in simple, economical and reliable manner by applying a metal-forming process to the blank plate body.

After insertion of the tube, the metal-forming process transforms the metallic plate body into the desired shape for achieving the press fit of the tube within the channel. The metal-forming process includes a permanent mechanical, i.e. plastic deformation of the blank metallic plate body. Possible metal-forming processes are for example forging, pressing or rolling of the metallic plate body. The metal-forming process can convert the plate body from blank condition into the finished condition of the cooling plate. While not excluded, an additional treatment is generally not required to achieve the press fit.

Preferably, the metal-forming process is applied locally along said at least one channel. Local application reduces the required effort or force to produce the press fit and therefore facilitates the machining process and reduces the requirements on the required equipment. For example, the press fit may be achieved by producing a permanent depression along said channel, e.g. on the rear face of the metallic plate body. Alternatively, the entire metallic-plate body may be subjected to the metal-forming process.

In a preferred embodiment of the method, the metal-forming process applied to the metallic plate body provides an elastic deformation of the tube so as to produce a pre-tensioned fit of the tube in the channel. By giving a predeter-

perimeter faces of the plate body. The perimeter faces are advantageously bevelled towards the rear face of the plate body, so that they form noses protecting the tube ends emerging out of the perimeter faces. To even better protect the tube ends emerging out of the perimeter faces, it is also possible to mill a recess into the perimeter face, so that the recess is open towards the rear face of the plate body and one of the channel openings lies within this recess.

A cooling plate for a metallurgical furnace in accordance with the present invention comprises a metallic plate body with a front face, a rear face and at least one metallic tube extending through the metallic plate body beneath the front face so that both tube ends protrude out of the plate body. There is a press fit between the metallic plate body and the at least one metallic tube. According to an important aspect, the plate body is plastically deformed along said channel. It will be appreciated that plastic forming of the blank plate body provides a predominant contribution to the press fit.

In a preferred embodiment, the metallic plate body comprises a bulge extending along said at least one channel. The bulge can be provided on the front or the rear face of the plate body, in proximity of the channel along which it extends. The bulge associated to the channel significantly facilitates the metal-forming process, or plastic deformation, of the region around the channel to obtain the press fit. Accordingly, the metal-forming process can be achieved by depression of the bulge with respect to the plate body. In order to further simplify the deformation an aperture is preferably provided within said bulge. In this case, the bulge is preferably located on the rear face of the plate body.

The plate body is advantageously made of copper or steel. The tube is preferably made of copper or stainless steel. It has been found that a combination of a plate body made of steel and a tube made of copper is particularly effective. Each of the protruding tube ends is advantageously bent so as to form a connection pipe-end pointing in a direction substantially perpendicular to a plane parallel to the rear face of the plate body.